rchives
21
4161

tation Bulletin 461 May 1959

Breeding and Improving Ornamentals

Three new late blooming lilacs. Left to right: Nellie Bean, Anna Amhoff, James Macfarlane.

By
A. F. YEAGER, E. B. RISLEY,
E. M. MEADER, R. B. PIKE

Agricultural Experiment Station
University of New Hampshire
Durham, New Hampshire

SHOUT
SHARE
IT

Foreword

In the breeding work with ornamentals, the following individuals should be credited as taking the lead in the following fields: E. B. Risley, roses, callas, gladiolus, and monarda; E. M. Meader, hardy chrysanthemums; R. B. Pike, conifers, rhododendrons and azaleas; A. F. Yeager, lilacs, coleus and gloxinia.

The color photo on the cover is made possible by a contribution from The Lilac Endowment Fund, which is sponsored by the New Hampshire State Federation of Garden Clubs.

Contents

Azalea 3

Calla 5

Chrysanthemum 5

Coleus 7

Evergreens, Dwarf 8

Geranium 10

Gladiolus 10

Gloxinia 11

Lilac 11

Monarda 13

Rose, Rambler 14

Breeding and Improving Ornamentals

By A. F. Yeager, E. B. Risley, E. M. Meader, and R. B. Pike

Azaleas

The breeding work with the group of rhododendrons which are known as azaleas has three objectives: 1. The production of superior seed propagated strains of our three native New Hampshire azaleas, 2. The production of azaleas roughly equivalent to the Ghent and Mollis hybrids that will be reliably hardy in northern New England, and 3. The production of azaleas akin to the semi-evergreen types that should be hardy in at least part of New Hampshire.

1. Rhodora (*Rhododendron canadense* Torr.), June Pink (*R. roseum* Rehd.) and Swamp Honeysuckle (*R. viscosum* Torr.) are our three native New Hampshire azaleas. All three are excellent garden plants in their superior forms. Since there is no practical means of vegetative propagation, presently known, it is necessary to try to produce strains of enough genetic purity to make seed propagation satisfactory. A deep colored, wide petaled selection of Rhodora upon selfing has produced even more attractive offspring and a selection of these has in turn been selfed. The resulting seedlings have not yet bloomed. It is hoped that this process of selfing can be continued until a high percentage of the seedlings are superior. However as Rhodora is one of the rare tetraploid azaleas this process may be long. In the meantime the possibility of vegetative propagation is being more fully explored.

A superior wild selection of June Pink (*R. roseum*) has been selfed and 200 progeny have been grown. These plants display considerable vegetative variation and it is thus assumed that there may be a comparable variation in flower color, form, cluster, size and scent from which further selection and breeding may be continued. Two plants with the highly desirable character of stoloniferous growth have already been selected for future breeding.

The Swamp Honeysuckle (*R. viscosum*) is still in the stage of first selection and a few hundred plants are being grown from collected seed to locate a superior plant or plants. Seed reproduction of superior forms will be attempted with this azalea as with the two former ones. *R. roseum* and *R. viscosum* are both diploids and if self fertility can be maintained a satisfactory degree of genetic purity may be more easily achieved than with *R. canadense* which is tetraploid.

2. In the second area of azalea breeding, i.e., the production of hybrids comparable to the Ghent and Mollis azaleas, we are using as parent stock only those species and individuals which are either native to New Hampshire or have demonstrated their hardiness here.

The species presently being used are the natives *R. roseum* and *R. viscosum*, two other eastern American species, the stoloniferous *R. atlanticum* Rehd. and the red flowered *R. cumberlandense* E. L. Br., and an Asiatic species *R. japonicum* Suringar.

Present progress includes the selection of parents for further breeding from an unusual progeny of *R. japonicum* which displayed extreme forms of color and stature. This progeny resulted from an attempt in 1950 to cross *R. japonicum* with *R. canadense*. No true hybrids appeared nor were the offspring identical with the female parent but they did show extreme expression of the female characters of flower color, foliage type and general growth habit. These may be homozygous individuals. Only future breeding results can answer this question. Successful crosses have been made between *R. roseum* and six selections of these *R. japonicum*. It will be another year at least before these bloom. Successful crosses have also been made with *R. japonicum* as either male or female parent and *R. viscosum* and *R. altanticum* but these are still in either the seed or early seedling stages.

A progeny of *R. altanticum x R. roseum* gave scattered bloom this year with a promising show of some of the better flower and plant characters of both.

Advantage was taken of this first bloom to make crosses with *R. viscosum* and selected *R. japonicum*, from which plump seeds have been harvested.

Another approach in this same group of azaleas is being made which may be productive of good results. This is backcrossing to the native species and *R. japonicum* of some of the Exbury azaleas which are the result of Lionel de Rothchilds' lifelong efforts in breeding azaleas. These English hybrids are the finest things yet seen in this section of azaleas but are of doubtful hardiness for New Hampshire. Crosses have been made with *R. roseum*, *R. atlanticum*, (*R. atlanticum x R. roseum*), *R. viscosum*, *R. cumberlandense* and several selections of *R. japonicum*. Although considerable sterility was evident some plump seeds resulted from each combination. Even if it is necessary to carry these progenies to the F_2 generation in order to carry them through our winters this approach deserves full exploration.

3. The third area of azalea breeding is based on two eastern Asiatic species of the *R. obtusum* group.

This *R. obtusum* group of azaleas is largely evergreen and includes the spectacular species and varieties used in gardens as far north as Washington, D. C. and Long Island, New York. *R. poukhanensis* Levl. from Korea and *R. kaempferi* Planch. from Japan have little evergreen tendency but are much hardier than any other species of the group. Specimens of both species have been growing in New Hampshire and Maine for years including *R. poukhanensis* collected in Korea by Elwyn Meader.

Our approach to this breeding project is to backcross the highly developed garden varieties to these species and follow through to the F_2 generation, hoping to combine hardiness with some of the finer qualities of the tender garden varieties.

Crosses have been made on *R. poukhanensis* and to a lesser extent on *R. kaempferi* with some of the U.S.D.A. Glendale hybrids and some of the Joseph Gable's hybrids. Plump seeds have been produced from the following combinations:

R. poukhanensis	x Dazzler (U.S.D.A.)
	x Zulu (U.S.D.A.)
	x Rose Greeley (Gable)
R. kaempferi	x Rose Greeley (Gable)

By the use of supplemental light in the greenhouse during the winter we hope to be able to accomplish the equivalent of several years of growth in one year and thus produce an F_2 generation for the field sooner than could be done out-of-doors.

Calla

In 1950, the Yellow Calla, *Zantedeschia elliottiana* Engler, was crossed with the Pink Calla, *Z. rehmannii* Engler, in an attempt to produce a dwarf, dark red calla that would make an attractive pot plant. An F_1 population of 20 cream-colored and 6 pinkish-cream colored flowers resulted. The pink-flowered plants had a few white leaf spots and pale green leaves. Seeds from the pinkish-flowered plants produced only F_2 seedlings of the same flower color but with darker green leaves than their parents. The cream colored flowers occurred on vigorous plants having dark green leaves and many white leaf spots. Seeds from these yielded an F_2 of 360 plants, all having cream colored flowers. When backcrossed to the yellow parent, the progeny had only cream colored flowers in various shades.

In 1953, another attempt was made to produce a red flowered calla by crossing the white flowered species, *Z. albo-maculata* Baill., with the Pink Calla. Pale pinkish flowered hybrids appeared in the first generation. From these a second generation may be grown when viable seeds are obtained from the hybrids.

To further test the breeding behavior of these callas, the cross, Yellow x White, *Z. albo-maculata* was made. All the progeny bore pale cream flowers, 4 out of 17 being nearly white. The leaf shape of these hybrids varied at random between the limits of the parent types.

Granite Series of Chrysanthemums

Following the collection of the wild *Chrysanthemum sibiricum* in the Pouk Han mountains of Korea by E. M. Meader in November, 1947, seeds were mailed to A. F. Yeager in Durham, New Hampshire. There the new plants proved fully winter hardy. Thus it became possible for crosses to be made with garden varieties. Male-sterile plants of *C. sibiricum* were caged with Nashua, Sunapee, Welcome, and several other varieties in the greenhouse. House flies which were released within the cage accomplished easily what would otherwise have been difficult cross pollinations. Reciprocal crosses and backcrosses were also made by a similar procedure. Thus it was possible with but little effort to grow several generations involving hundreds of seedlings.

At no time was winter protection given to the field-grown seedlings and those propagated for testing had to withstand at least three successive winters in the open field before being considered for final selection. Those having blossoms readily injured by the first fall frosts were discarded as

One of the Granite series chrysanthemums.

well as hundreds of plants, many with beautiful flowers, which did not prove fully winter hardy.

After this rigid selection for hardiness the following ten clones having attractive blossoms were named and introduced by the New Hampshire Agricultural Experiment Station in 1955 as the Granite Series. The first seven are long stemmed varieties suitable for cut flowers while the last three have low-growing plants.

Granite Glow — Single, yellow flowers having two rows of petals markedly resistant to fall frosts.

Granite Buttercup — Burnt gold pompom flowers.

Granite Harvest — Light orange, semidouble flowers with yellow center.

Granite Ranger — Semi-double, brick-red flowers.

Granite Promise — A single flower with several rows of brick-red petals.

Granite Enchantment — Intermediate pompom flowers, orange in color.

Granite Gem — Strong-growing, cushion type plant, with double lemon-yellow flowers.

Granite Bronze — Double flowers, resistant to frosts.

Granite Pageant — Very floriferous with rusty, red, single flowers with long narrow petals.

In general the Granite Series of varieties at Durham, N. H. have had good foliage even though neither fungicides nor insecticides have ever been used in their cultivation.

Two additional selections meeting the requirements for winter hardiness of the Granite Series were named March 22, 1957. One (NH #LR) having brick-red color with a 2¾-inch fully double flower has been called Granite Pleasure. The other, an early-blooming double white (NH #W-9) has been named Granite Truth. It is not fully frost hardy in the fall but starts flowering August 15 and gives at least one month of garden beautification before heavy frosts. Plants of the Granite Series are available from nurserymen.

Colchicine Treated Coleus

To teach a class of students how to use colchicine in plant breeding, a common ornamental coleus plant, *Coleus blumei* Benth., grown in the greenhouse, was treated with this material in 1953. The original plant had leaves with a green border next to a red area and with maroon color at the leaf center. The apical growing points were removed from two plants 8 inches tall and then they were immersed in one half of one percent colchicine solution for about 20 hours. The idea was to see what the effect of doubling the chromosomes might have on the color of the leaves, if any. From these two plants, 42 lateral shoots were removed and rooted. Among the 42 rooted cuttings there were 7 color variations, all distinctly different from the original plant and from each other.

These seven selected plants were grown for a year and increased by division to 20 plants of each clone. During this time, they retained the differences originally noted. Chromosome counts were made from root tips from plants of each clone by a graduate student, Dr. D. L. Craig. It was found that the original plant had 48 chromosomes. Of the 7 variants, 2 had 48 chromosomes, 3 had 72 chromosomes, one had 96 chromosomes and another approximately 96. Thus what resulted from the colchicine-treated plants was two new color patterns with no increase in chromosome number, three new ones which had half the chromosomes doubled producing triploids, and two which had all chromosomes doubled and were tetraploids. Those which had the doubled number of chromosomes were weak plants with narrow irregular leaves and rather poor root systems. The ones with 72 chromosomes were much stronger even than the original plants. Of the ones which had the same chromosome number as the original, one was weak and died.

These results have indicated a behavior of plants following colchicine treatment different from what is ordinarily expected. They tend to confirm the findings of the South Dakota Experiment Station with Sorghum where somatic segregation was found to have resulted from colchicine treatment. Seemingly colchicine offers some possibilities in breeding other than the doubling of chromosomes which some some have assumed to be its direct effect.

Colchicum in a border planting. The bulbs of this plant furnish colchicine.

Dwarf Evergreens

An effort is being made to find dwarf evergreens suitable for use in northern New England. Present day architectural styles demand such material and the list of such shrubs hardy enough for our climate is very limited. A search is being made among our native evergreens for dwarf and unusual forms that may have ornamental and other horticultural qualities.

Many of the dwarf evergreens now in use originated as witches brooms. Witches brooms are unusual or abnormal forms of growth usually caused by fungus or other infections. These growths may occur on almost any woody plant but are most striking and often very beautiful on coniferous evergreens. Cuttings taken from such growths usually maintain the original characteristics such as dwarf stature or dense foliage or whatever other qualities may have made the witches broom notable.

A little searching of the roadsides and pastures of New Hampshire and Maine have given us a number of these witches brooms from several species which we are now testing for ease of propagation and general horticultural properties.

The following have been located and are being tried.

Witches Broom in a larch tree. This is typical of many such growths found on conifers.

Juniperous horizontalis Moench. (This is the Seaside Juniper — not to be confused with the Common Pasture Juniper of New Hampshire). Many witches brooms on this species were found in eastern Maine of which nine were selected for trial. As found these growths ranged from one to three feet in height and were of varied growth patterns from narrow columnar to broadly pyramidal. All were of dense growth with the foliage of the juvenile needle-like type rather than the mature scale-like form. Propagation of these forms has been successful and limited numbers of them are in the field to observe growth and general behavior as independent plants.

Larix laricina Mill. Numerous witches brooms were also found on this species in eastern Maine and although it is deciduous it is a beautiful conifer. Several of these witches brooms are of a very dense desirable growth up to 7 or 8 feet in diameter. Three selections have been tried for propagation in the cutting bench and as yet none have been successful. Other rooting teachniques or even grafting may be necessary.

Pinus resinosa Ait. — Red or Norway Pine. An unusually fine witches broom was found on this species which measured approximately 12 ft. wide by 5 or 6 ft. high. From hundreds of cuttings none rooted following a variety of treatments. Pines are possibly the most difficult of all evergreens to root from cuttings and other methods may have to be used.

Pinus strobus L. — White Pine. Five witches brooms have been found on this species three of which have been collected and propagation trials made. One was unsuccessful and two others are still being tried. Again other techniques may be necessary.

Abies balsamea Mill. — Common Balsam Fir. Witches brooms are very common on this species but almost always have some serious defect for ornamental purposes. However of the few attractive ones found two have rooted successfully and are being grown in the field for observation. A very recent acquisition shows the most desirable shape and foliage characters of any we have seen. Dwarf forms of this evergreen should be among the best for severe climates.

Picea glauca (Moench) Voss. *P. rubens* Sarg. and *P. mariana* (Mill.) B.S.P. Spruces; White, Red and Black. Witches brooms on these species also usually have serious ornamental defects possibly due to the fact that the organism causing the abnormal growth is often the parasitic dwarf mistletoe which is itself undesirable.

Partial success has been had with one specimen from White Spruce and two from Black Spruce.

In addition to dwarf evergreens originating as witches brooms there are also other possibilities, the genetic dwarfs and those which might be called physiological dwarfs. The genetic dwarfs are found as naturally occurring seedlings either in nurseries or in the wild.

The only recorded genetic dwarfs of the red pine were found in Wolfeboro, New Hampshire, 50 years ago. These are now beautiful plants 15 feet across and nearly as tall. As yet they have not been successfully propagated.

Tsuga canadensis L. (Carr.) — Hemlock. Gentic dwarfs and variants of this species appear with some frequency but few of them have been selected and propagated. We have one from Franklin, New Hampshire which has rooted successfully. We have located a number of others and are searching for more. This species widely regarded as the finest of the conifers holds great promise of dwarf horticultural forms for northern gardens.

Picea species — Spruce. One genetic dwarf native spruce has been found with superior ornamental qualities that shows some promise of propagation. We would like to locate more specimens.

Juniperus communis L. — Common Pasture Juniper. Although regarded by farmers as a pasture weed this species has unusual ornamental possibilities because of its variation in stature from prostrate to columnar. A very fine group of the columnar shape has been located in New Hampshire and is being given field trial. Propagation is quick and easy. As a hedge plant it should be superior.

Juniper hybrids. A large group of naturally occurring hybrids between *J. virginiana* crebra Fern. & Grisc. (Red Cedar) and *J. horizontalis* (Seaside Juniper) has been located on the Maine coast. This is a most remarkable group of plants that vary in height from a few inches to 5 or 6 feet and in width from 3 to 15 feet or more. Foliage color varies from dark green to blue gray. Many selections are now in the propagating benches to test for rooting response.

A genetic variant of the White Pine *(Pinus strobus)* of a handsome columnar shape and fine foliage has been located in Bedford, New Hampshire and cuttings from it are now in the propagation bed.

Of many forms that may be found whether witches brooms or genetic variants only a limited number respond to present propagation techniques and of these only a fraction will have enough other horticultural qualities to make them valuable.

However continued search and trial can eventually give us a list of dwarf and other horticultural forms of native evergreens that will be suited to our climate and needs, and should be second to none in beauty.

Geraniums

A seedling geranium of unknown parentage, grown by P. J. Durkee at the New Hampshire Agricultural Experiment Station greenhouses, was named White Mountain, and distributed to New Hampshire florists in 1955. It has double white flowers on a clean, bushy plant that has good growth habits under glass.

Another seedling having purple red flowers has been found valuable for landscape purposes. It has been named Purple Heart. Compared with the British Horticultural Color Chart, the petals shade from Solferino purple, #26—26/1, in the center to Rose Bengal #25 at the margins while the inner halves of the two upper petals are Vermillon #18 veined with Rose Madder #23.

Gladiolus

During the period 1947 to 1955, about twenty-three thousand hybrid gladiolus seedlings were grown and evaluated in an attempt to develop a multiple stalked, small flowered, disease resistant variety for home garden use in New Hampshire. Gladious improvement requires the growing of large populations. From these seedlings, a few selections having one or more of the desired qualities were made. Several of these selections have been sent to other gladious breeders in the New England area for their use in continued breeding.

Gloxinia

In 1953 Mrs. J. H. Sanborn, Seed Analyst, New Hampshire Agricultural Experiment Station, pollinated the flowers of Gloxinia, *Sinninga speciosa* Benth. and Hook. with pollen from African Violet, *Saintpaulia ionantha* Wendl. Repeated attempts to get seed by self-pollinating this particular gloxinia plant had failed. When the gloxinia flowers were pollinated with pollen of the African violet, they set pods and produced seed. This seed when planted produced thirty plants. They gave no evidence of being hybrids yet were not as vigorous as normal gloxinia plants. When grown to maturity, they produced typical gloxinia flowers of several colors. An examination of the anthers showed that no good pollen was produced by any of the plants. None of them produced any seeds.

Root tip chromosome counts by R. B. Pike showed them to be haploids. Attempts were made to double the chromosome number by soaking the leaves in colchicine solution without success.

Lilacs

James Macfarlane Lilac

The common lilac, *Syringa vulgaris* L., is well adapted to New Hampshire. In some years, though the plants are fully winter hardy, they either fail to bloom or else produce ragged clusters of flowers because of late spring frosts which injure the blossom buds before they open. Some other species of lilacs bloom rather late, hence escape such damage to the flowers. In our lilac trials, one of the best late-blooming varieties is Royalty which is a variety of the hybrid species *Syringa prestonae* McKelvey.* Open-pollinated seeds from Royalty have given many desirable plants. One of the best has been named James Macfarlane in memory of the former well-known florist at the University of New Hampshire.

Lilac 'James Macfarlane' has beautiful bright pink flowers. The florets are single, the clusters large and branching. The variety blooms at an early age, often on one-year-old rooted cuttings. It is particularly valuable as a large shrub in landscape plantings or as a specimen shrub. Some years James Macfarlene has produced a second flush of blossoms in July about a month after the normal season for flowering. Propagation of this variety from two-leaf, softwood cuttings taken when the plants are in full bloom is fully satisfactory.

Nellie Bean Lilac

Nellie Bean was a sister seedling to James Macfarlane and resembles the latter variety in many respects. Nellie Bean has purple flowers instead of pink. This variety was named in honor of a former leader in the State Federation of Garden Clubs which through its Lilac Foundation Fund supports the lilac research work. Nellie Bean can be propagated readily from softwood cuttings.

---

* Royalty is commonly listed as a cultivar in the group *S. josiflexa* P. but records of the Dominion Experimental Farm, Morden, Manitoba, Canada, indicate Royalty to be a hybrid of *S. villosa* x *S. reflexa* selected at that station from seeds produced in 1922.

The James Macfarlane lilac. It is a late pink.

Anna Amhoff Lilac

This variety, named for a woman who for many years was a leader of the Portsmouth Garden Club, is the third in the series of new late-blooming varieties descended from Royalty. The flowers of Anna Amhoff when fully open are white. Before the flower buds open, they are light pink. This variety is more difficult to propagate from softwood cuttings than its sister varieties.

Miss Kim Lilac

So far as we know Miss Kim lilac is the first named variety of the species *Syringa velutina* Komarov (Syn. *S. palibiniana* Nakai). One of seven seedlings raised from seeds collected by E. M. Meader in the Pouk Han Mountains of Korea in 1947, Miss Kim was named in 1954. It is a late lilac, hence escapes frost damage when common lilacs are injured. Its fragrant blossoms are lavender in color. One outstanding characteristic of Miss Kim lilac is its small stature which makes it more desirable than other lilacs

for general landscape work. Morover, the leaves turn a burgundy-red color in fall. This variety can be propagated readily from softwood cuttings.

Maybelle Farnum Lilac

This variety was named June 18, 1958. It is a seedling of James Macfarlane pollinated by a very dense cluster selection of our own breeding descended from Royalty. It blooms about two weeks later than common lilac. The dense shouldered clusters are about nine inches in length. The florets are single and of a lilac purple color. Propagation from softwood cuttings is possible but it is not as easily rooted as James Macfarlane.

Other Late Lilacs

From crosses between James Macfarlane and Anna Amhoff, several desirable plants have been chosen for further testing.

Since Anna Amhoff has been found difficult to propagate from softwood cuttings, a white-flowered selection which can be propagated readily in this manner is the most likely to be named.

Mary Blanchard Lilac

This variety belongs to *Syringa vulgaris*, the common lilac. It is an open pollinated seedling of Congo and was distributed for trial as N. H. #70.

The flower clusters average eight inches in length, the florets are one inch in diameter, single and the buds are purple when first open but become violet in full bloom. It was named June 3, 1958. It may be propagated by softwood cuttings.

Interspecific Lilac Hybrids

What was thought to be a hybrid between the common lilac, *Syringa vulgaris* L. and *S. amurensis japonica* (Maxim) Fr. and Sav., mentioned in New Hampshire Agricultural Experiment Station Bulletin 383, has proved to be only a seedling of the late-flowering species. Other attempts to make the cross since have given some plants but probably none are hybrids. Also attempts have been made to cross Miss Kim, and *S. amurensis japonica.* If crosses between the late-blooming species can be made, some most interesting seedlings should result.

Monarda

In 1955, Monarda 'Granite Pink' was released by the New Hampshire Agricultural Experiment Station to nurserymen and home gardeners. This member of the mint family, growing three feet tall and as wide across, and covered with soft pink flowers from July to September, is an open-pollinated seedling of a taller variety, 'Croftway Pink'.

New Hampshire florists have found 'Granite Pink' useful for cut flowers when field grown. In the greenhouse it will produce a spring cut flower crop from cuttings taken in January from dormant stock plants forced in a 50°F. greenhouse. The color is a true pink which does not clash with the colors

A sample of Monarda in the breeding block.

of other flowers in mixed bouquets. Plants of 'Granite Pink' were sold in most all states of the United States in 1958.

'Granite Purple' was introduced in the summer of 1958. The flower color is an official "Cyclamen Purple 30" by the British Horticulture Color Chart and the calyxes are green. The leaves are pubescent and taper straight-sided from a base half as broad as the total leaf length. The leaf margins have large single teeth from the base to the tip and the leaves are outstanding in their disease resistance and long life on the plant each season. The husky, square-angled stems grow about four feet tall and bear up to six large flowers per stem. Good plants, two years old from cutting or divisions will be four feet in diameter and in full bloom during the first two weeks in August.

Modern hybrid Monardas (Bee Balms) contain genes from two native North American wild flowers; the bright red Oswego Tea, *M. didyma* L., of moist, shady woodlands and Wild Bergamot, *M. fistulosa* L., the lavender-flowered species of dry, open fields. Until recently all garden hybrids have been produced in England where seeds of our native species were sent as early as 1744. 'Croftway Pink' was introduced from England during World War II. 'Granite Pink' was produced at Dover, New Hampshire in 1953, and 'Granite Purple' was raised in the same location a year later.

Monardas with flowers of other colors are now being developed with emphasis on plants having attractive, disease free leaves and good compact growth habit. This hardy perennial is a minimum-maintainence plant adaptable to most soil types. Wherever they are grown, the Bee Balms attract bees, humming birds and the interesting humming-bird sphinx moths in large numbers.

Rambler Roses

The canes of most varieties of rambler roses now available to home gardeners will freeze and die back when the minimum temperature falls below -15°F in the winter. It is, therefore, an exceptional winter in nearly all parts of New Hampshire when unprotected rambler rose canes do not freeze and die. Loss of flowers results the following summer. These canes may be protected by burying then under a foot of garden soil, however this is not always possible and, at best, is not convenient. The objective of the breeding program on rambler roses has been the development of canes which would withstand temperatures as low as -20° or -25°F. without injury. Among the seedlings raised, selection has been made also for disease resistant leaves, vigorous growth, ease of propagation, and a tendency to repeat blooming all summer long.

To accomplish this purpose, a collection of species and hybrid roses from various parts of the world was made at the Horticulture Farm of the N. H. Agr. Exp. Station starting in 1950. It was known that ramblers or long, flexible caned roses differ genetically from bush or short, stiff caned roses by only one, or very few genes. It was also known that garden and wild roses are complex hybrids, often isolated from breeding with one another by various types of incompatibility. Thus the number and viability of seeds to be expected from the cross breeding of any two roses and the probable nature of their offspring are unpredictable.

The following account describes three named cultivars resulting from this project and gives an idea of the general nature and breeding behavior recorded for the many rose species and varieties involved.

White Mountains

Distributed for testing as N. H. #5217, this vigorous rambler resulted from the self-pollination of Skinners Rambler in 1952. Its small white flowers are borne in large clusters along the previous years' canes in late June. The individual flowers have 45 petals and resemble the "sweetheart" type rose in the bud. These flowers have remained on the plant in good condition for as long as 37 days, turning greenish white with age. The canes are slender, thorny and vigorous but not rampant. Additional plants are easily propagated from Summer cuttings and all plants have been completely winter hardy at Durham, N. H. The leaves are of the *R. multiflora* type, bright green and disease free for the most part. "White Mountains" has crossed readily with other roses. This rambler produces large numbers of small fruits, green in color, that mature viable seeds early in the fall.

White Mountains hardy climbing rose.

Skinners Rambler, the parent variety, was generously donated for this work by Dr. Frank L. Skinner, plant breeder and nurseryman, of Dropmore, Manitoba, Canada. It is a vigorous seedling of *Rosa maximowizziana* Regel having five pink petals, flowers in clusters in June on the preceeding years' canes, and sets viable seed with a number of unrelated pollen parents. It has 14 chromosomes and is therefore a diploid rose.

Grafton Pillar

Bright red, double flowers in large clusters produced continuously from June until severe frost characterize this rose. Distributed for testing as N. H. #551, it is a second generation seedling of Skinners Rambler x Gruss an Aachen. (see chart). The flowers have 30 petals and are in terminal clusters on canes two to eight feet long which places it in the classification of a pillar rose needing the support of a fence or post but not growing as long canes as a rambler rose does. The canes are hardy at -20°F but the leaves have a mild susceptability to both mildew and blackspot diseases. Spraying with a good fungicide is recommended as a regular part of the care of this variety. Leafy stem cuttings taken in July root and grow very easily.

Gruss an Aachen, the first floribunda rose, is a dwarf, everblooming rose whose canes are not hardy. It is a triploid rose having 21 chromosomes as verified in this project, yet it produced the viable pollen used on the 14 chromosome, Skinners Rambler to produce a 14 chromosome seedling designated as SR3GAA. From this, 78 plants were grown in the F_2 generation. One of these had double flowers (30 petals) and two were everblooming.

Grafton Pillar rose is double flowered, everblooming, and red.

Durham Pillar

Durham Pillar rose, a hardy, everblooming, disease-resistant variety.

Distributed for testing as N. H. #536, this is an open pollinated seedling of Chevy Chase rambler. The unique feature of Durham Pillar is its apparent freedom from both blackspot and mildew diseases. The leaves are a glossy, olive green and are thick and relatively rigid. In the greenhouse the plant is an evergreen and continues growth all winter at 70°F but will not flower under glass. In the garden it blooms continuously from June to frost in large clusters terminal to the pillar-length canes. The flowers have five petals and are red. The canes winter-kill to the soil line at temperatures below 17°F but growth and flowering are satisfactory from the short basal canes as from a floribunda rose when it has been protected by mounding with soil. This variety seems to have some drought resistance and seems to grow more vigorously in warm seasons. Durham Pillar has 14 somatic chromosomes. It is a second generation seedling of *Rosa soulieana* Crepin by a dwarf red China Rose hybrid which had the appearance of a Polyantha variety.

It is suggested that Durham Pillar be used in a sunny exposure trained on a low fence, against a stone wall or on a trellis or post where a total plant height of four to eight feet is desirable. No fungicide is needed and it is hoped that rose breeders will make use of this cultivar to produce a race of disease free garden roses.

Other Seedlings

The following numbered seedlings are included in this record of rambler rose breeding because they have been distributed for testing or have been referred to in one or more publications in various ways. It is possible that some of these may be useful for further breeding work.

N. H. #5211 (Skinners Rambler self-pollinated). A sister seedling of White Mountains, this one has great clusters of double pinkish magenta flowers, and makes an extremely vigorous and rampant growth. The stout, thorny and bristly canes bear *Rosa multiflora* type leaves not fully as shiny as those of 'White Mountains'. Propagation of N. H. #5211 from cuttings is easy. It is also a good seed parent.

N. H. #541 (an open-pollinated seedling of N. H. #5211). Having double white flowers like White Mountains, this one has dark, shiny green *Rosa multiflora* type leaves that are free of blackspot and mildew diseases.

Thus the leaves remain on the plant long after frost. So far N. H. #541 has not produced viable seeds. It was selected primarily for its excellent foliage. The flowers are of poor quality.

N. H. #5425 (Skinners Rambler x Yellow Pinocchio). Handsome glossy foliage, rampant canes, and 25-petaled flowers of apricot color and hybrid tea shape characterize this rose. The canes are not hardy at Durham, N. H. without winter protection. The flowers are sterile, a condition typical of offspring from crosses involving the diploid Skinners Rambler and tetraploid hybrid tea varieties. Prepared slides of N. H. #5425 root-tips when examined under the microscope revealed more or less equal numbers of cells having 16, 17, 18, 19 and 21 chromosomes. The anticipated number was 21. Since it blooms but once in June, introduction as a named variety is doubtful.

N. H. #5414 (open-pollinated seedling of White Mountains). A botanical curiosity, this thick caned rose bears a few twice-compound leaves. The canes are covered with bristles but lack all thorns. It has 14 chromosomes in the root tips.

N. H. #524 (Skinners Rambler x Betty Bland). *Rosa blanda* Ait. is a thornless, extremely hardy species native to this area. Its genes were introduced into a cross with Skinners Rambler through the use of the variety, Betty Bland. Seedling N. H. #524 is virtually thornless and has red canes that are completely winter hardy. They are, however, subject to attack by cane girdlers. The rather unattractive flowers have 29, small, magenta and white-striped, irregular petals. The few seeds which have been produced have failed to germinate. The leaves are dull, pale green and drop from the canes early in the autumn.

N. H. #5314 (Skinners Rambler x *Rosa virginiana*). A single seedling resulted from this cross made in 1953. This seedling has all the taxonomic features of the pollen parent, *Rosa virginiana* Mill. but has produced no seeds. A single seedless fruit produced in 1957 was like those of Skinners Rambler, the seed parent. Apparently no other visible characteristics were inherited from the maternal parent and this is the only seedling of Skinners Rambler that has inherited bush form in the F_1. Like both its parents, N. H. #5314 has 14 chromosomes. Taxonomically, the pollen parent is typically *R. virginiana* but is a diploid. Most *R. virginiana* are tetraploid.

Other Crosses Involving Skinners Rambler

Skinners Rambler has repeatedly been pollinated by the Apple Rose, *Rosa pomifera* Hermm. Only two seedlings have resulted. One of them, N. H. #5246 has proliferated carpels within the double pink flowers. The other seedling resembled a wild *R. multiflora* Thunb. rose and from it an F_2 population of 76 plants has been grown. All were similar to their parent and showed no evidence of hybridity involving the Apple Rose.

The Apple Rose is one of the Caninae group which produces pollen bearing seven chromosomes and egg cells having the seven mates plus 14 extra chromosomes, thus giving the plants a somatic tetraploid number of 28. Very different offspring would thus be expected from a cross in which the Apple Rose was the seed parent than if it were the pollen parent.

Another Caninae rose, *Rosa eglanteria* L., the Sweetbriar, has been used in rose breeding to introduce genes for fragrant foliage. It is a pentaploid species having a total somatic chromosome number of 35 but the pollen

carries only seven of these chromosomes. In this project nine seedlings were grown from the cross *R. eglanteria* x N. H. #5211 rambler and one from Skinners Rambler x Lady Penzance (*R. eglanteria* x *R. foetida bicolor* (Jacq.) Willm.). These have not been fully evaluated but do exhibit the usual first generation characteristics of Sweetbriar hybrids. Seedlings in which the maternal parent was Sweetbriar strongly resemble that species with such minor variations as stem and flower color, extra petals, etc., and the fruity fragrance of the foliage has been retained. Seedlings in which Sweetbriar was the pollen parent exhibit little if any noticable resemblance to that species. Those few second generation seedlings of Sweetbriar that anyone has been able to grow since the first hybrids were produced around 1895 are said to resemble that species in all respects.

Attempts to cross both the Damask Roses and French Roses, hybrids of *Rosa damascena* Miller and *Rosa gallica* L. respectively, with Skinners Rambler have resulted in very few seeds and no worthy seedlings. Oratam is a hybrid Damask rose having large flowers and a strong perfume. Nineteen seedlings from the cross Skinners Rambler x Oratam inherited the fragrance, copper flower color, leaf type and armature of Oratam, but also extreme susceptability to blackspot. All of them are sterile. Eleven other seedlings having no Oratam features resembled vigorous, wild species, *R. multiflora*.

Skinners Rambler was crossed with Bonfire, a double flowered, red, multiflora-type rambler and an F_1 population of 63 seedlings was grown. All grew vigorously until attacked by mildew and all were discarded.

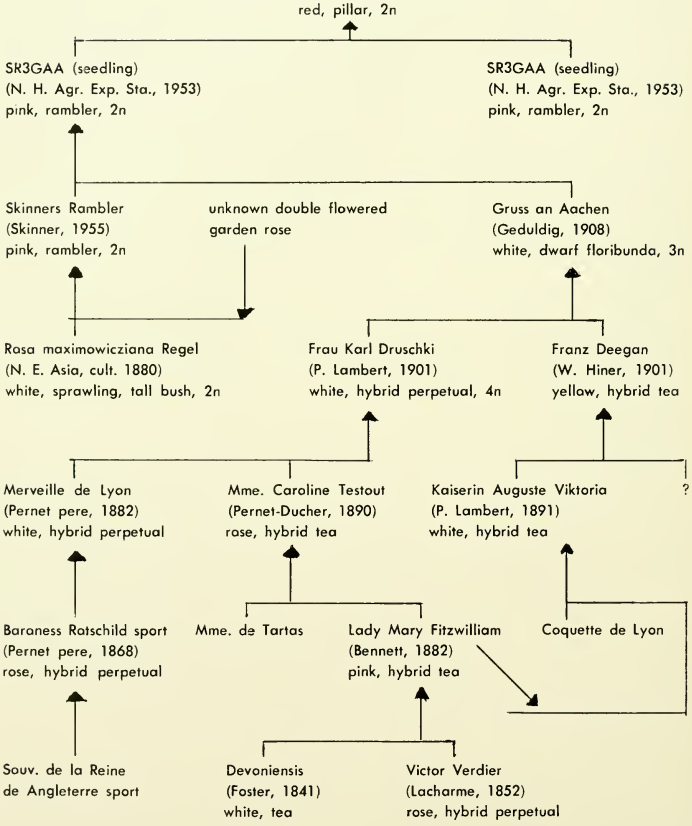
Skinners Rambler x *Rosa rubrifolia* Vill. yielded only seven seedlings following repeated pollinations and none of these had any resemblance of the Redleaf Rose. *R. rubrifolia* is another of the Caninae roses which is tetraploid but has only 7 chromosomes in the pollen.

Perhaps the most luxurious, wrinkled, dark green foliage of any rose is that of Max Graf, a hybrid of *Rosa rugosa* Thunb. and *Rosa wichuraiana* Crep. It has long flexible canes and large, single, pink flowers. Max Graf has 14 somatic chromosomes and is nearly sterile. Skinners Rambler x Max Graf yielded an F_1 population of 24 plants, all thin caned, small leaved ramblers that are not particularly resistant to mildew disease.

N. H. #500 (*Rosa wichuraiana* x Betty Bland). This is believed to be the first successful cross involving the genes of *Rosa wichuraiana* and *R. blanda*. A thin, red caned rambler with single pink flowers that rarely produce seeds, N. H. #500 is extremely winter hardy. This hardiness comes from the pollen parent, Betty Bland, which N. H. #500 resembles in many of its characteristics. It has 14 somatic chromosomes.

GRAFTON PILLAR ROSE

N. H. Agricultural Experiment Station, 1958)



E. B. Risley, 1958